Local Climate Analysis Tool
LCAT Demo

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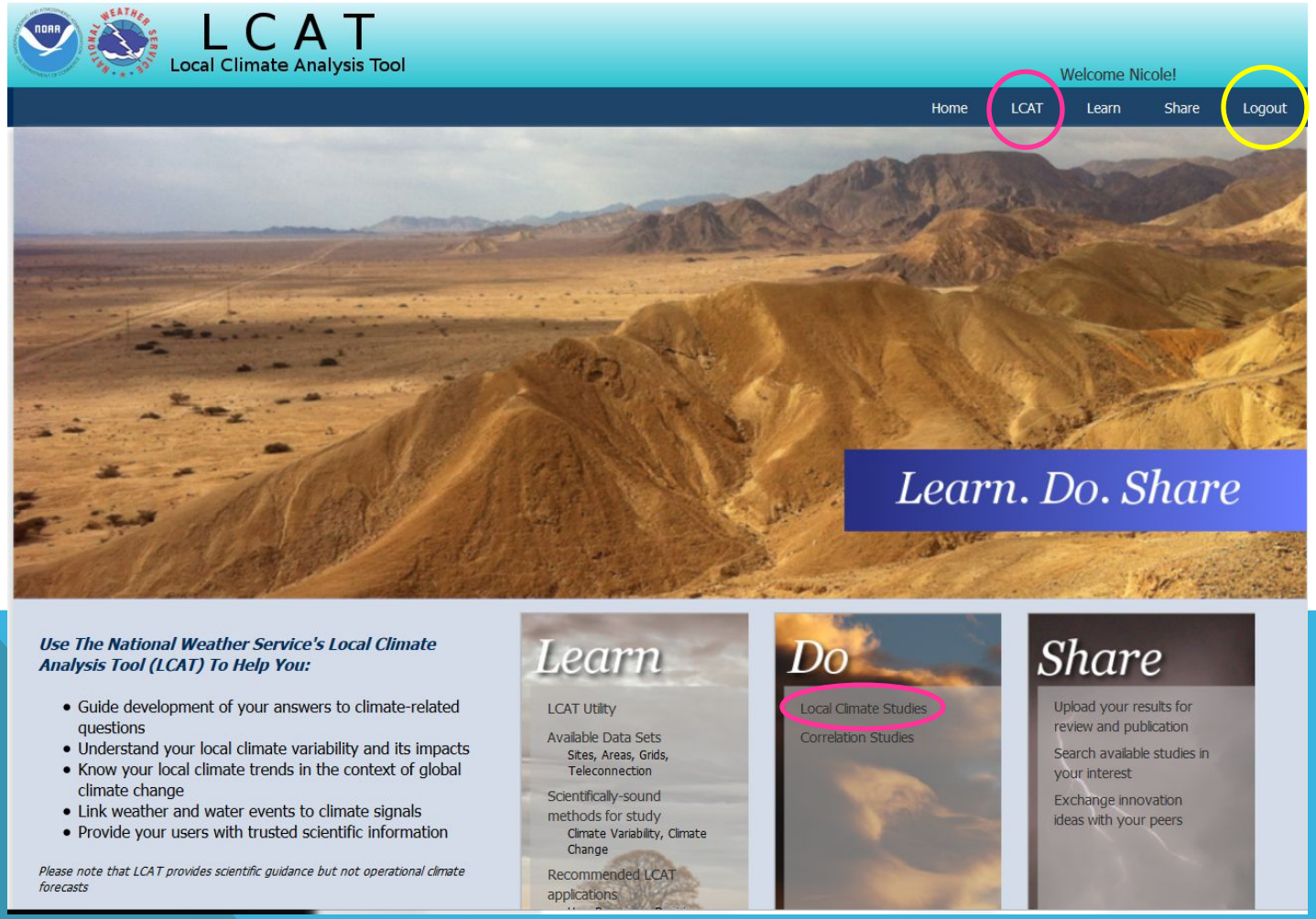
Tulsa, OK

National Climate Services Meeting
May 9-12, 2016

Getting Started

http://nws.weather.gov/lcat/home

Log in and navigate to the LCAT Local Climate Studies



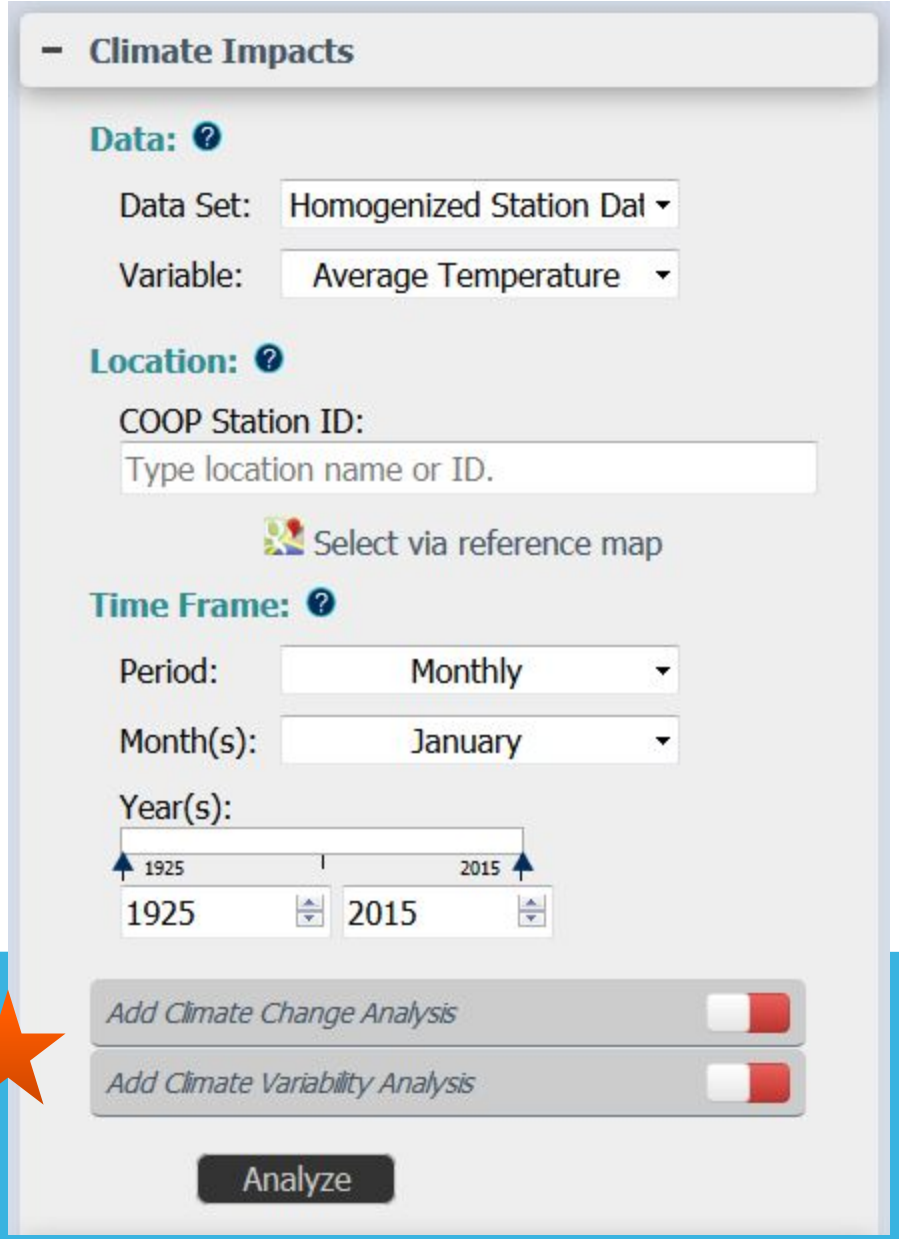
LCAT Analysis Options

Climate Change Analysis

- How is the climate changing over time?
- Is the climate change signal greater than the climate variability?
- Is there a trend in the data?

Climate Variability Analysis

- Is there a statistically significant relationship with large scale climate patterns?
  - ENSO, AO, NAO, PDA



Use Climate Change Analysis to adjust for trend for Climate Variability Analysis!

Climate Change Analysis – Quick Review

- **Hinge trend** method helps to understand the **current rate of climate change**
- Other methods (**OCN, EWMA**) help you to analyze how climate **normals are changing** over time
- To look at Climate Change (CC) in the context of Climate Variability (CV) you can use a simple ratio of the annual rate of change and Hinge RMSE (Beta = ROC/RMSE with units of "per year")
- This ratio helps assess the magnitude of CC impacts in the context of CV – how does CC compare to CV?
- A ratio of Beta = 0.05 per year is a big deal (meaning CC is overwhelming CV)
- Values closer to zero show that CV is so large, that the CC is within the context/magnitude of CV, and therefore, less concerning.
- 1/Beta = 1/0.05 = 20 years is a big deal (meaning CC is overwhelming CV)
  - This means we are warming at a rate that gets us to a point 20 years faster than natural variability would have warmed us on its own.
- The bigger the CV or the smaller the ROC, the less obvious the CC impact.

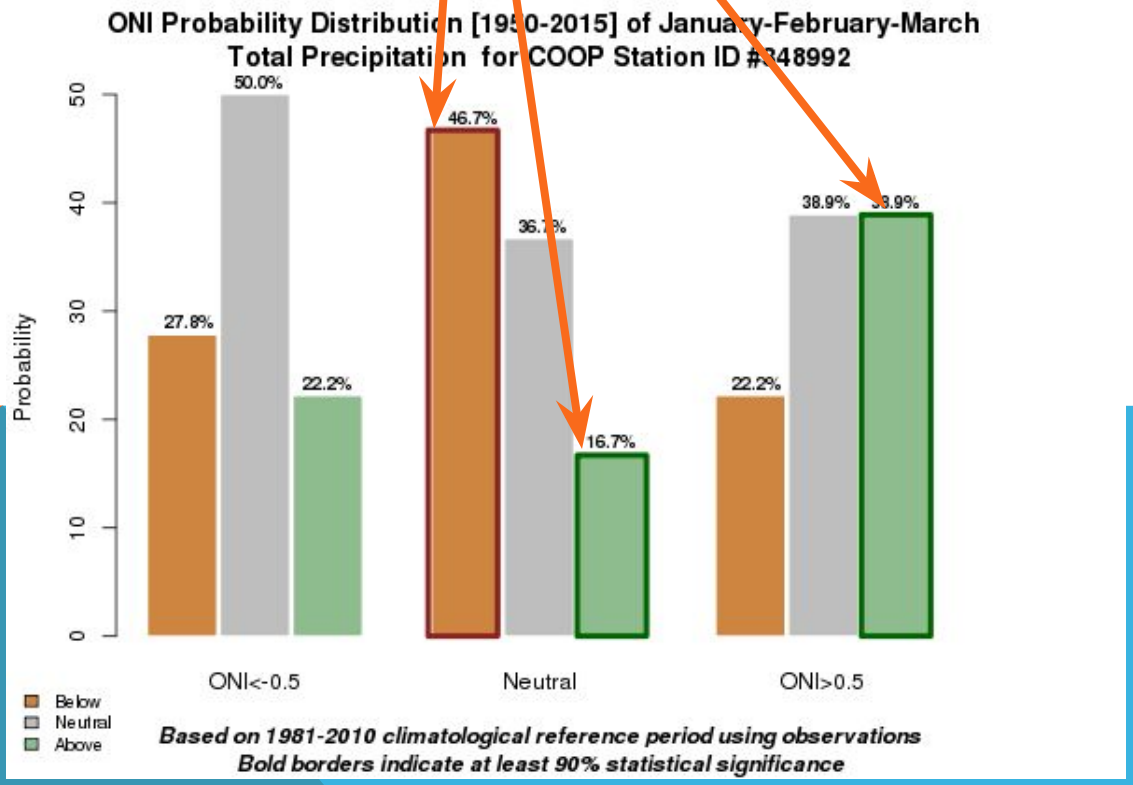
$$CC > CV \text{ when } \frac{Annual\ Rate\ of\ Change}{Hinge\ Trend\ RMSE} \geq 0.05$$

$$CC > CV \text{ when } \frac{1}{Beta} \leq 20 \text{ years}$$

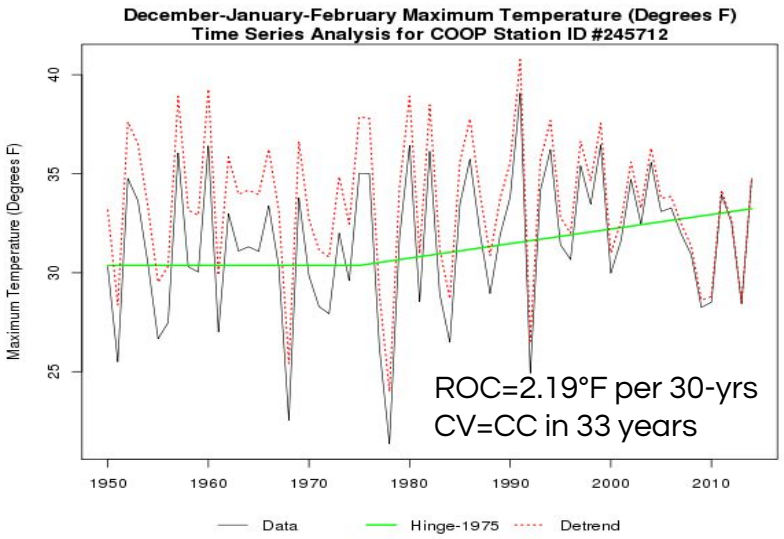
Climate Variability Analysis – Quick Review

Composite Analysis

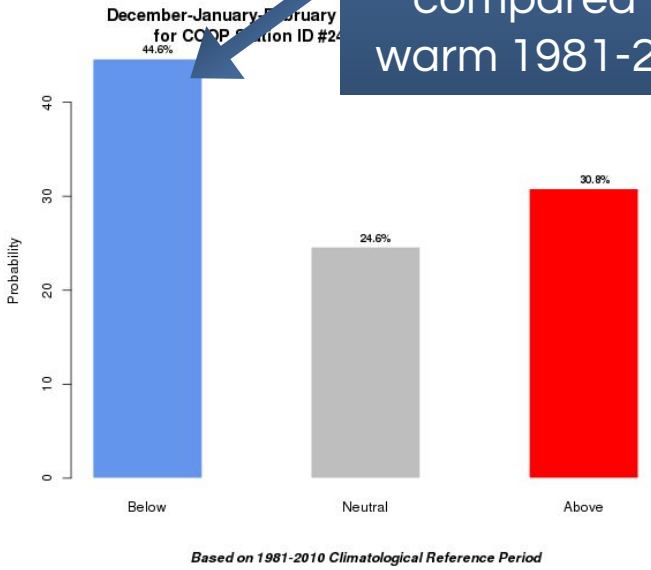
- Shows 90% confidence with **bold** borders
- During El Nino events, we can say with 90% confidence, there is an increased chance (tilt in odds) the rainfall will be above normal.
- During ENSO Neutral, we can say with 90% confidence, there is an increased chance (tilt in odds) the rainfall will be below normal and a decreased chance the rainfall will be above normal.



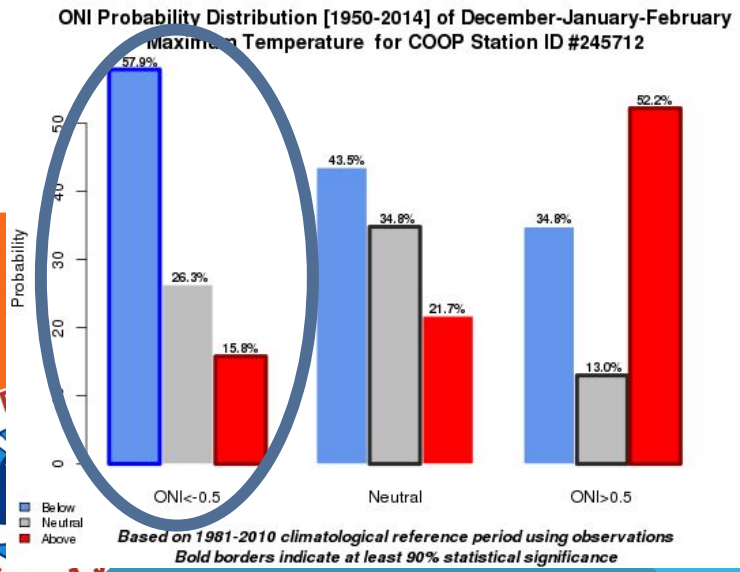
Accounting for Trend



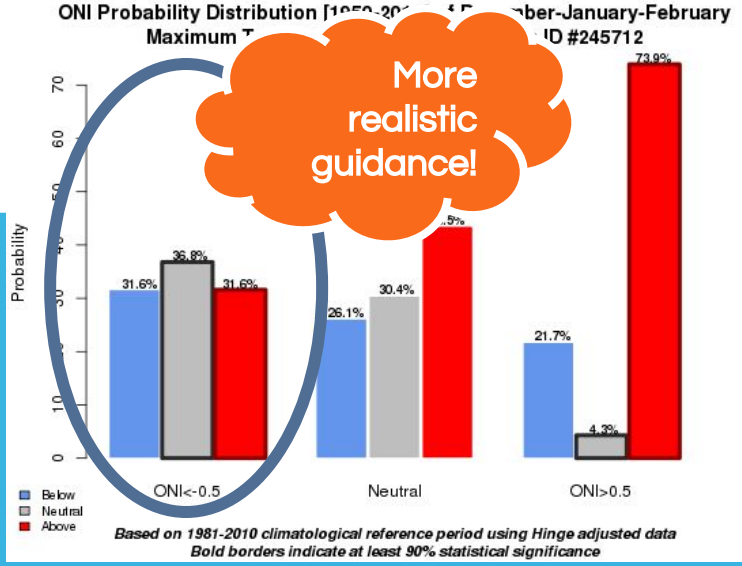
many Below Normal years compared to warm 1981-2010



Trend is NOT Adjusted



Trend is Adjusted

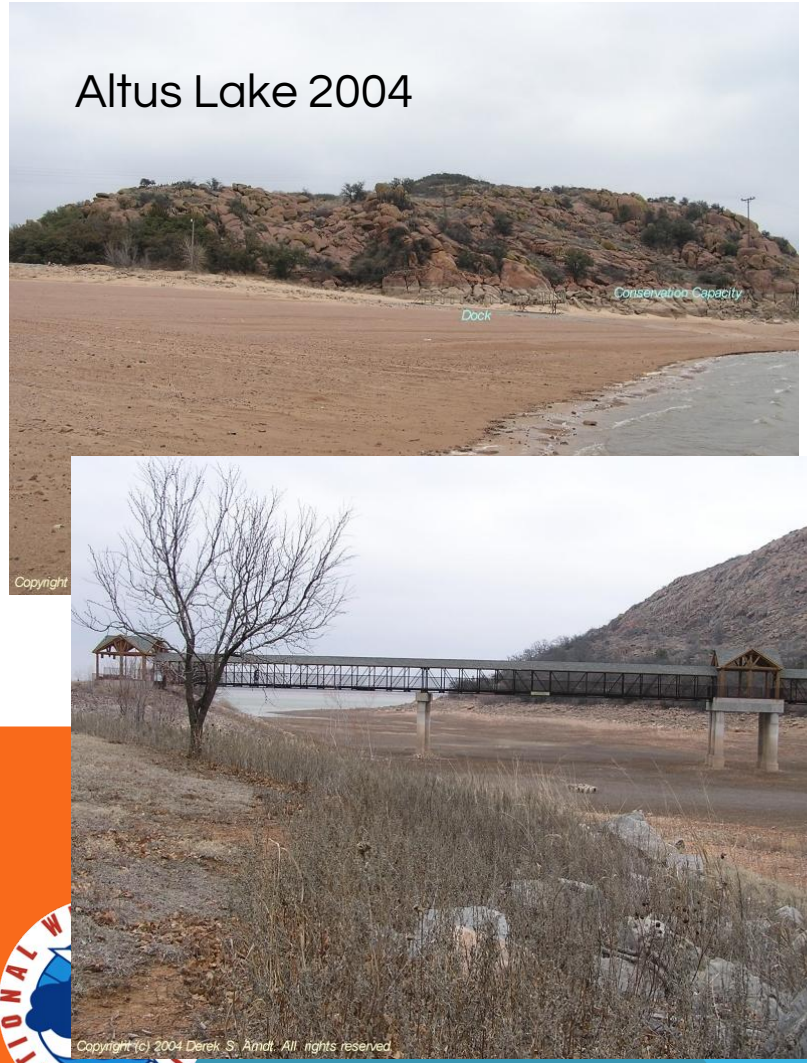


LCAT Demo

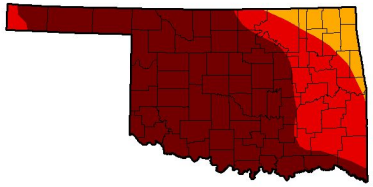
http://nws.weather.gov/lcat/home

Climate Questions?

Is climate change making drought more frequent in southwest Oklahoma? Does ENSO play a role in drought conditions?



U.S. Drought Monitor
Oklahoma



September 13, 2011
(Released Thursday, Sep. 15, 2011)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

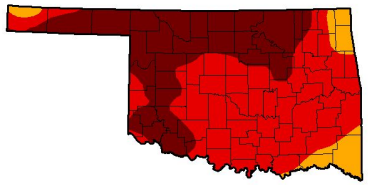
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	100.00	92.59	68.93
Last Week 9/6/2011	0.00	100.00	100.00	100.00	85.44	69.15
3 Months Ago 6/14/2011	22.11	77.89	57.87	41.76	33.53	10.32
Start of Calendar Year 1/4/2011	8.81	91.19	12.53	1.85	0.00	0.00
Start of Water Year 9/28/2010	66.28	33.72	4.21	0.00	0.00	0.00
One Year Ago 9/14/2010	50.13	49.87	7.72	0.00	0.00	0.00

Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Mark Svoboda
National Drought Mitigation Center

U.S. Drought Monitor
Oklahoma

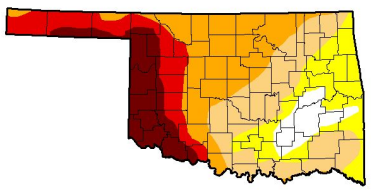


January 29, 2013
(Released Thursday, Jan. 31, 2013)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	100.00	92.14	39.58
Last Week 1/22/2013	0.00	100.00	100.00	100.00	91.80	39.58
3 Months Ago 10/30/2012	0.00	100.00	100.00	99.43	67.64	27.13
Start of Calendar Year	0.00	100.00	100.00	100.00	94.89	32.06

U.S. Drought Monitor
Oklahoma



April 8, 2014
(Released Thursday, Apr. 10, 2014)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D
Current	6.34	93.66	76.48	52.63	26.39	13
Last Week 4/1/2014	4.05	95.95	77.48	50.67	24.03	8
3 Months Ago 1/7/2014	50.84	49.16	38.17	18.99	4.84	2
Start of Calendar Year 12/31/2013	50.84	49.16	38.17	18.99	4.84	2
Start of Water Year 10/1/2013	21.74	78.26	43.00	17.62	4.42	1
One Year Ago 4/9/2013	0.70	99.30	85.01	61.00	36.44	8

Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brian Fuchs
National Drought Mitigation Center

http://droughtmonitor.unl.edu/

Is climate change making drought more frequent in southwest Oklahoma?

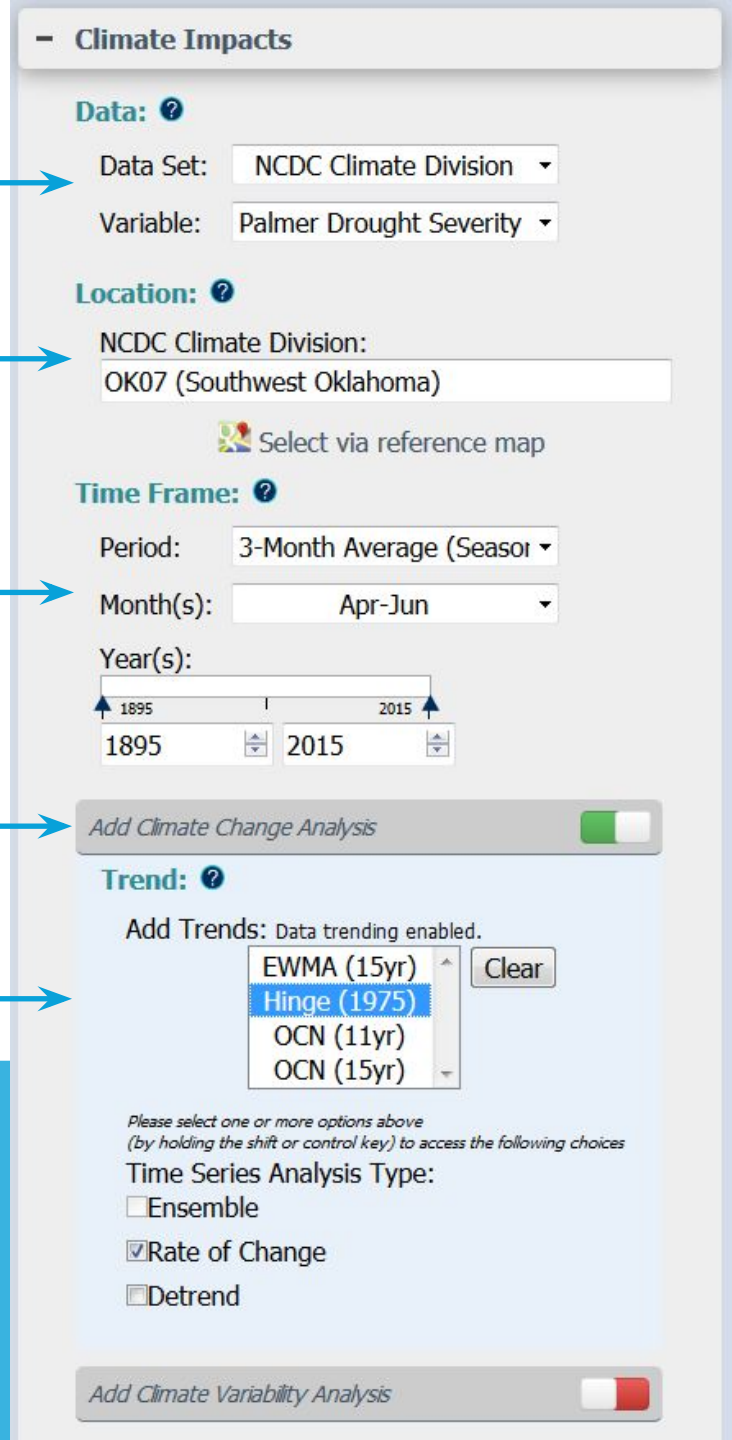
1) Select Data

2) Select Location

5) Select Time Frame
(double check before clicking Analyze)

3) Turn "ON" CC Analysis

4) Make Trend selections



Is CC > CV?

$$\frac{Annual\ Rate\ of\ Change}{Hinge\ Trend\ RMSE} \geq 0.05?$$

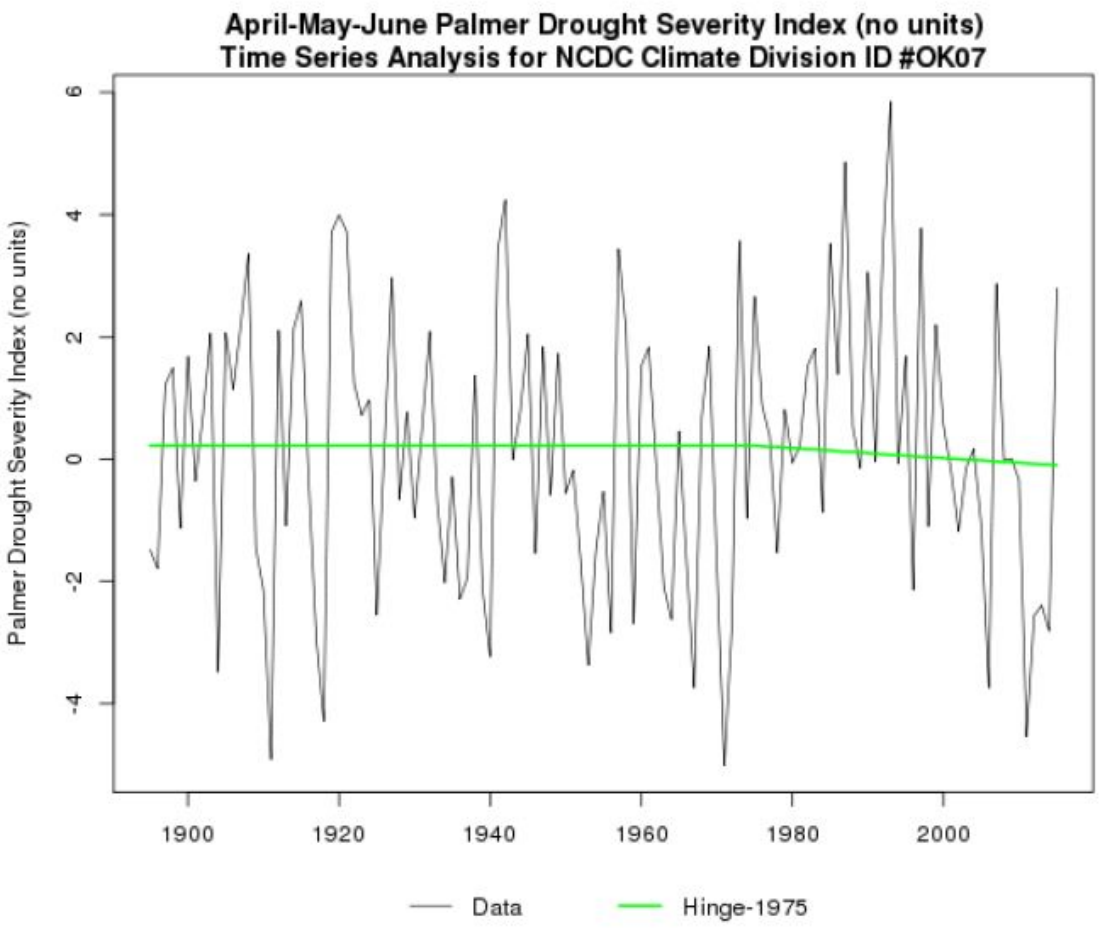
or $\frac{1}{Beta} \leq 20$ years?

$$\frac{-0.008}{2.20} = -0.003$$

$$\text{or } \frac{1}{-0.003} = -333 \text{ years}$$

* The Climate Change signal is well within the range of natural variability (noise).

* There is virtually no recent trend (post 1975) or long-term trend in the Palmer Drought Severity Index during AMJ.



Data	Statistics
Mean	0.02
Median	-0.07
Mode	-3.74
Minimum	-5.01
Maximum	5.85
Standard Deviation	2.316
Skewness	0.154
Kurtosis	-0.414

Rate of Change

Annual_ROC	-0.008 No units per year
Decadal_ROC	-0.08 No units per decade
Climo_ROC	-0.24 No units per 30-year period

Trend Performance

Root Mean Square Error

Hinge-1975:	2.20 No_units

Does ENSO play a role in drought conditions in southwest Oklahoma?

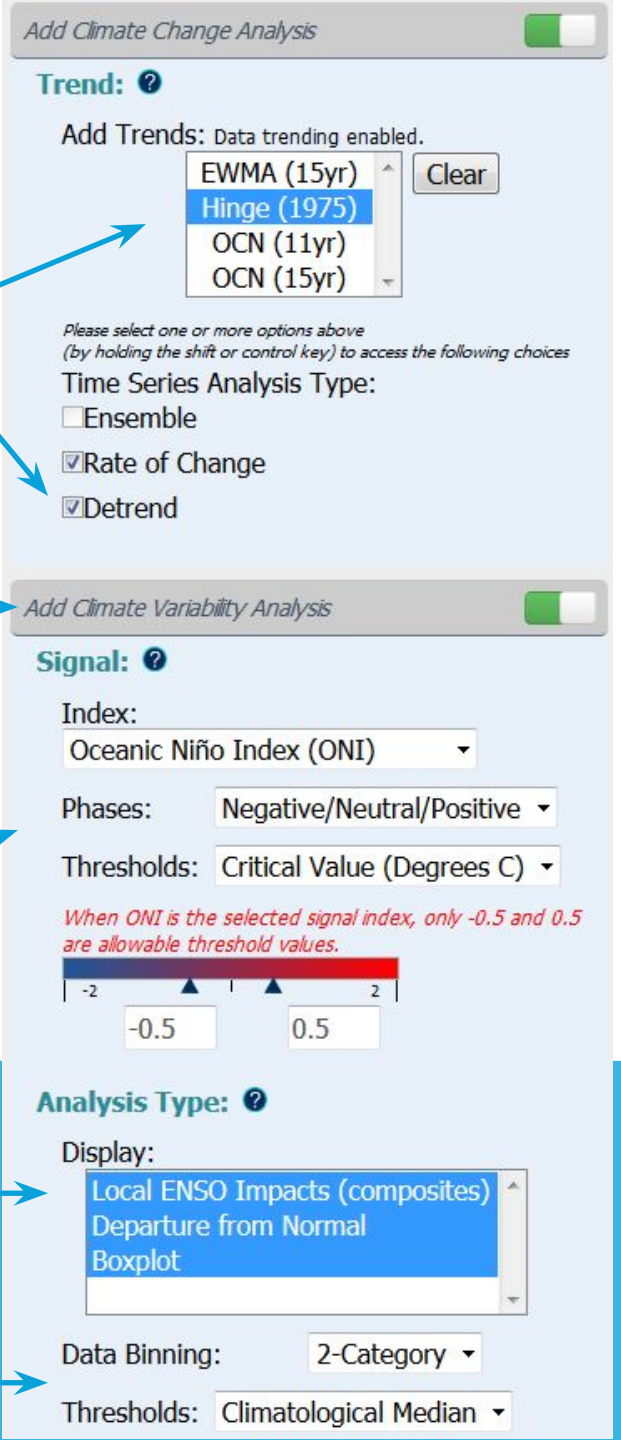
1) Check on "Detrend" (Verify the Trend type)

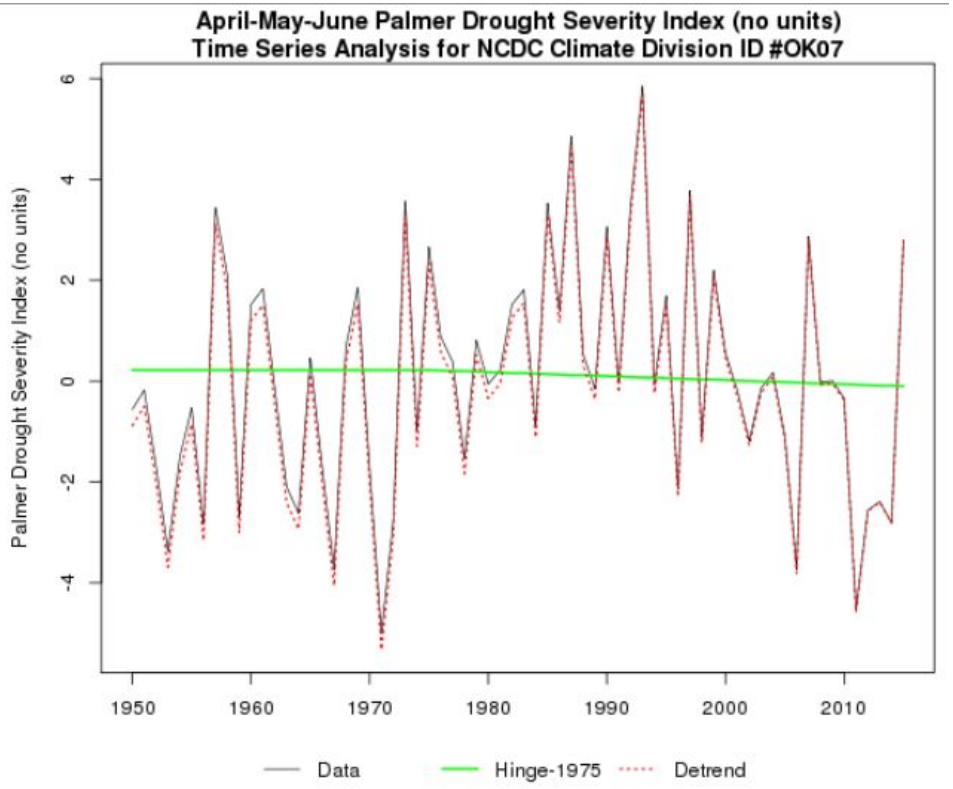
2) Turn "ON" Climate Variability Analysis
Double check Time Frame above!

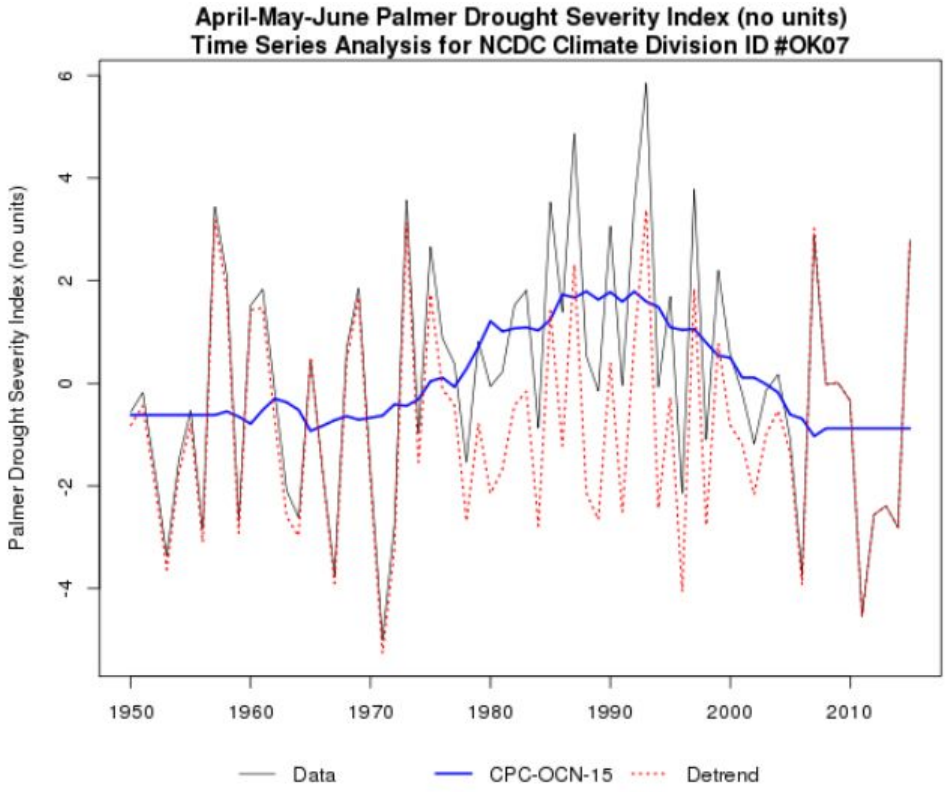
3) Select Index & parameters

4) Select Analysis Display Types

5) Select Data Binning/Thresholds




April-May-June Palmer Drought Severity Index (no units)
Time Series Analysis for NCDC Climate Division ID #OK07
Palmer Drought Severity Index (no units)
6
4
2
0
-2
-4
1950
1960
1970
1980
1990
2000
2010
Data
Hinge-1975
Detrend


April-May-June Palmer Drought Severity Index (no units)
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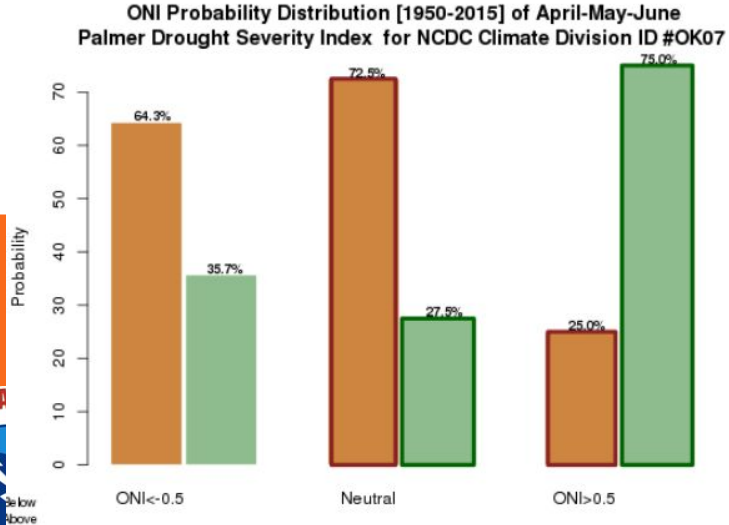
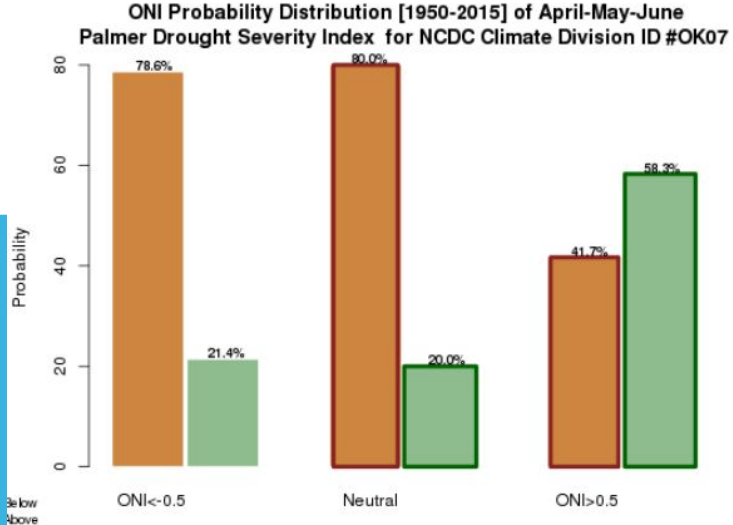
6
4
2
0
-2
-4
1950
1960
1970
1980
1990
2000
2010
Data
CPC-OCN-15
Detrend


ONI Probability Distribution [1950-2015] of April-May-June
Palmer Drought Severity Index for NCDC Climate Division ID #OK07
Probability
70
60
50
40
30
20
10
0
64.3%
35.7%
72.5%
27.5%
25.0%
75.0%
ONI<-0.5
Neutral
ONI>0.5
Based on 1981-2010 climatological reference period using Hinge adjusted data
Bold borders indicate at least 90% statistical significance


ONI Probability Distribution [1950-2015] of April-May-June
Palmer Drought Severity Index for NCDC Climate Division ID #OK07
Probability
80
60
40
20
0
78.6%
21.4%
80.0%
20.0%
41.7%
58.3%
ONI<-0.5
Neutral
ONI>0.5
Based on 1981-2010 climatological reference period using OCN-15 adjusted data
Bold borders indicate at least 90% statistical significance

Significance Level

Using 1981-2010 Median for the binning threshold:

Signal Data	Number of Events	Below Bin <= 0.20		Above Bin > 0.20	
		% Chance	Significance	% Chance	Significance
ONI < -0.5	14	64.3%	76.0%	35.7%	76.0%
ONI Neutral	40	72.5%	97.9%	27.5%	97.9%
ONI > 0.5	12	25.0%	99.6%	75.0%	99.6%
Total Years	66				

- The **PDSI** is calculated based on **precipitation and temperature data, as well as the local Available Water Content (AWC) of the soil.** It is standardized.
- From the inputs, all the basic terms of the water balance equation can be determined, including evapotranspiration, soil recharge, runoff, and moisture loss from the surface layer.
- Human impacts on the water balance, such as irrigation, are not considered.

PDSI Value	Descriptor
> 4.00	Extreme Moist Spell
3.0 to 3.99	Very Moist Spell
2.0 to 2.99	Unusual Moist Spell
1.0 to 1.99	Moist Spell
0.50 to 0.99	Incipient Moist Spell
-0.49 to 0.49	Near Normal
-0.50 to -0.99	Incipient Drought
-1.00 to -1.99	Mild Drought
-2.00 to -2.99	Moderate Drought
-3.00 to -3.99	Severe Drought
< -4.00	Extreme Drought

Significance Level

Using 1981-2010 Mean for the binning threshold:

Signal Data	Number of Events	Below Bin <= 0.88		Above Bin > 0.88	
		% Chance	Significance	% Chance	Significance
ONI < -0.5	14	78.6%	80.4%	21.4%	80.4%
ONI Neutral	40	80.0%	98.2%	20.0%	98.2%
ONI > 0.5	12	25.0%	99.9%	75.0%	99.9%
Total Years	66				

* Binning threshold could be far away from Zero
  - For PDSI, the brown shading may contain moist spell values!
* Always check the actual data and don't rely solely on the graphs!

PDSI Value	Descriptor
> 4.00	Extreme Moist Spell
3.0 to 3.99	Very Moist Spell
2.0 to 2.99	Unusual Moist Spell
1.0 to 1.99	Moist Spell
0.50 to 0.99	Incipient Moist Spell
-0.49 to 0.49	Near Normal
-0.50 to -0.99	Incipient Drought
-1.00 to -1.99	Mild Drought
-2.00 to -2.99	Moderate Drought
-3.00 to -3.99	Severe Drought
< -4.00	Extreme Drought

Climate Questions?

Is climate change making drought more frequent in southwest Oklahoma?

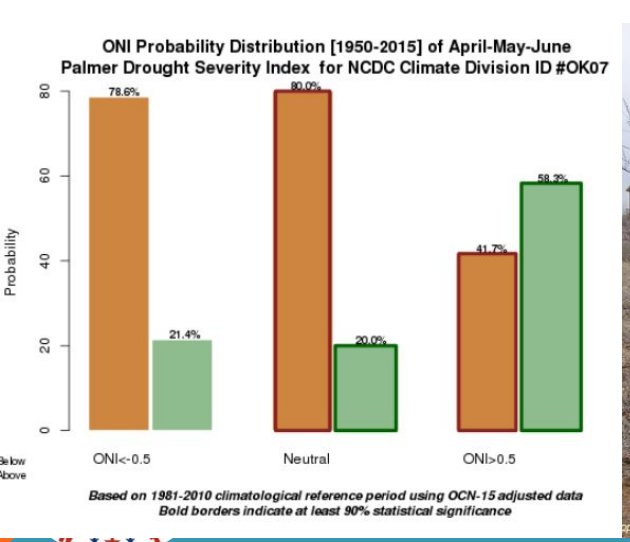
No. The Climate Change signal for the Palmer Drought Severity Index is within the range of natural variability in April-May-June.

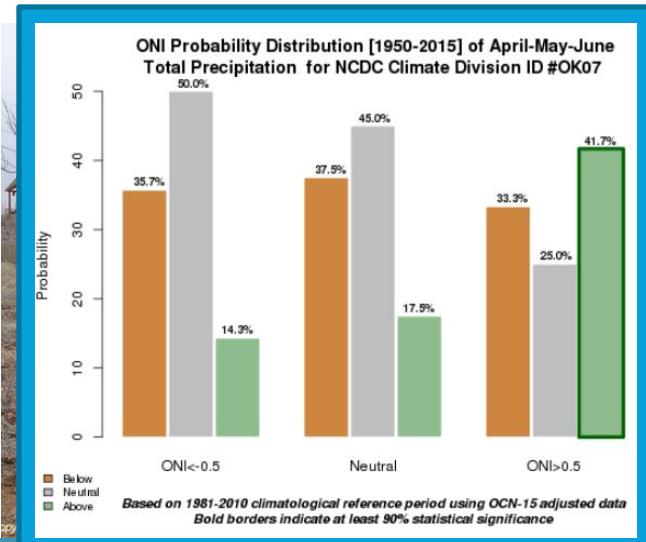
There is virtually no recent trend (post 1975) or long-term trend in the Palmer Drought Severity Index during April-May-June.

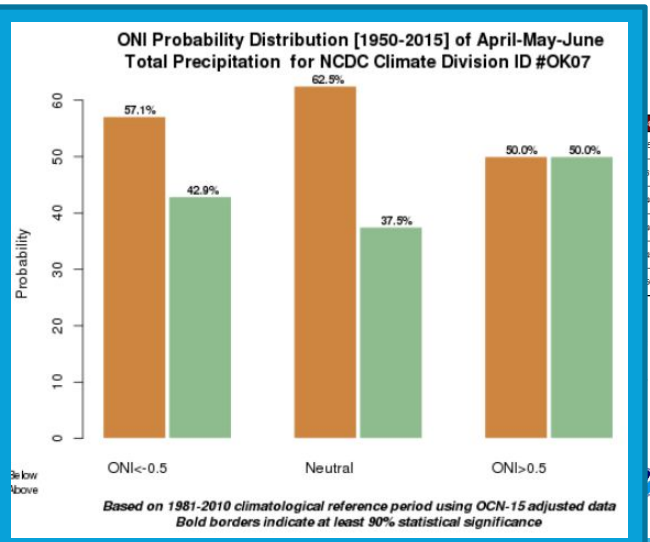
Does ENSO play a role in drought conditions?

Yes. During El Niño events, we can say with 90% confidence, there is an increased chance (tilt in odds) for moist spells and a decreased chance for drought conditions in April-May-June.

During ENSO neutral times, we can say with 90% confidence, there is an increased chance (tilt in odds) for drought conditions and a decreased chance for moist spells in April-May-June.







Local Climate Analysis Tool
LCAT Demo

Questions?

National Climate Services Meeting
May 9-12, 2016

NCEI Climate at a Glance (CAG): *Primer*

Deke Arndt
NOAA's National Centers for Environmental Information

May 2016 NWS Climate Services Get Together

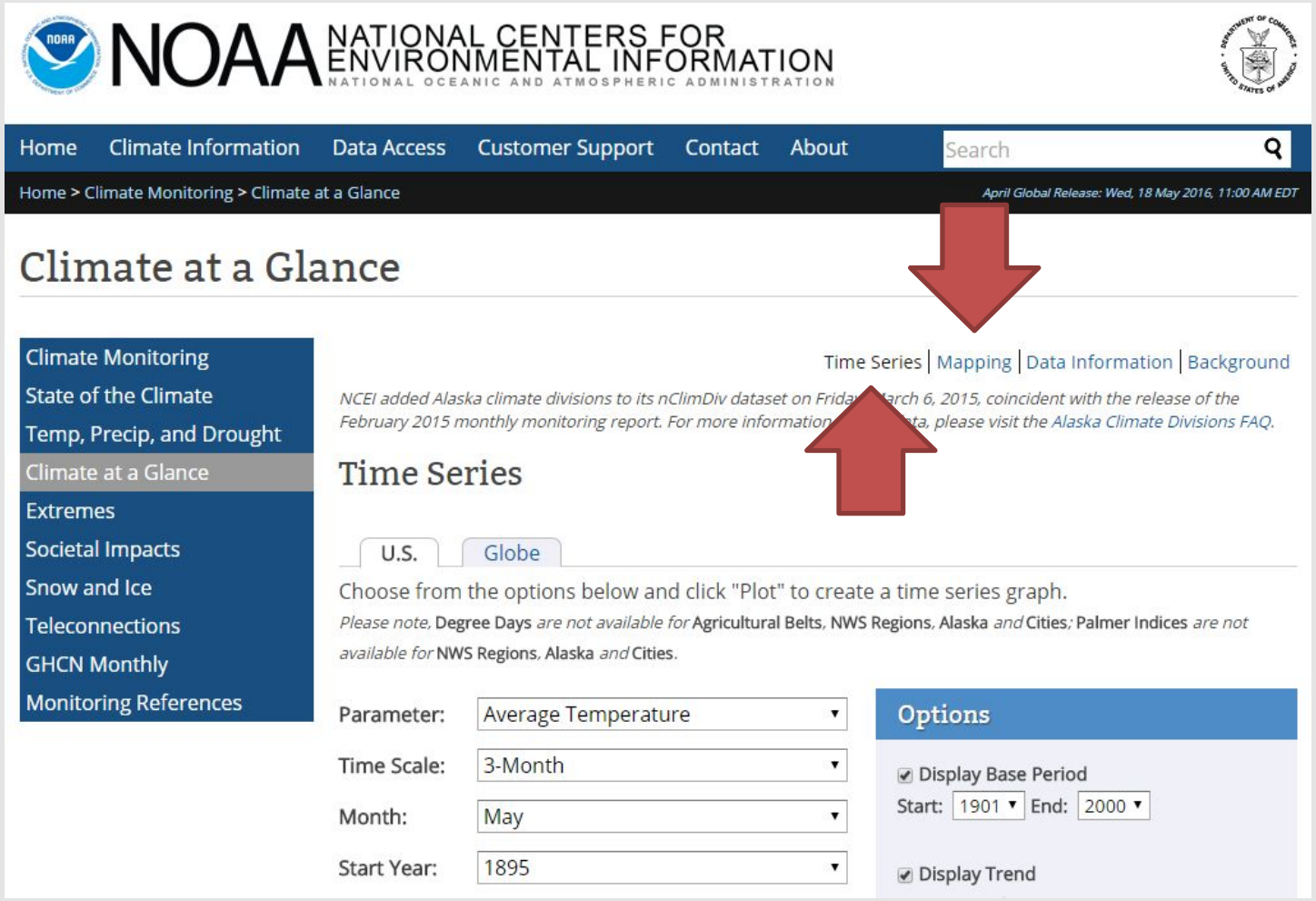
CAG: https://www.ncdc.noaa.gov/cag

- CAG is one of several basic tools developed during NCEI's ~70 years of climate services experience
- It fits the model of most successful "eyeball to eyeball" climate services:
  - Relatively simple tool; relatively complex usage;
- This week, AMS will develop an app that uses CAG data to teach advanced statistics
  - This was not an original "requirement", but results from building tools to meet requirements

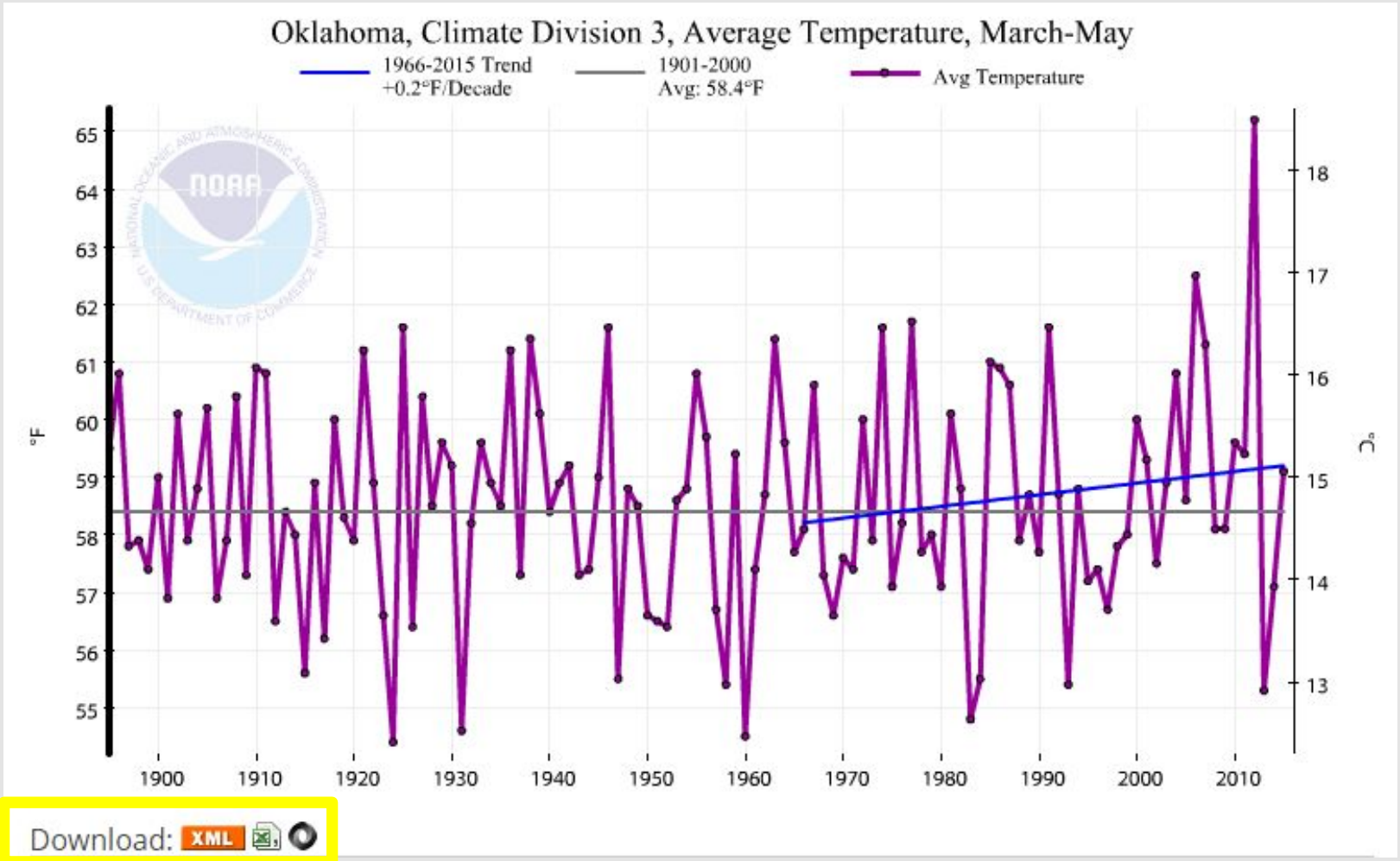
CAG “requirements”

- Service four of the five ligaments of climate monitoring:
  - **Observation**: what was observed
  - **Departure**: how different is that from a base period
  - **Unusualness**: how unusual is that difference
  - **Trend**: is this part of a bigger picture?
- It doesn’t service the most expensive monitoring facet:
  - **Impact**: what did it cost (property, [quality of] life)

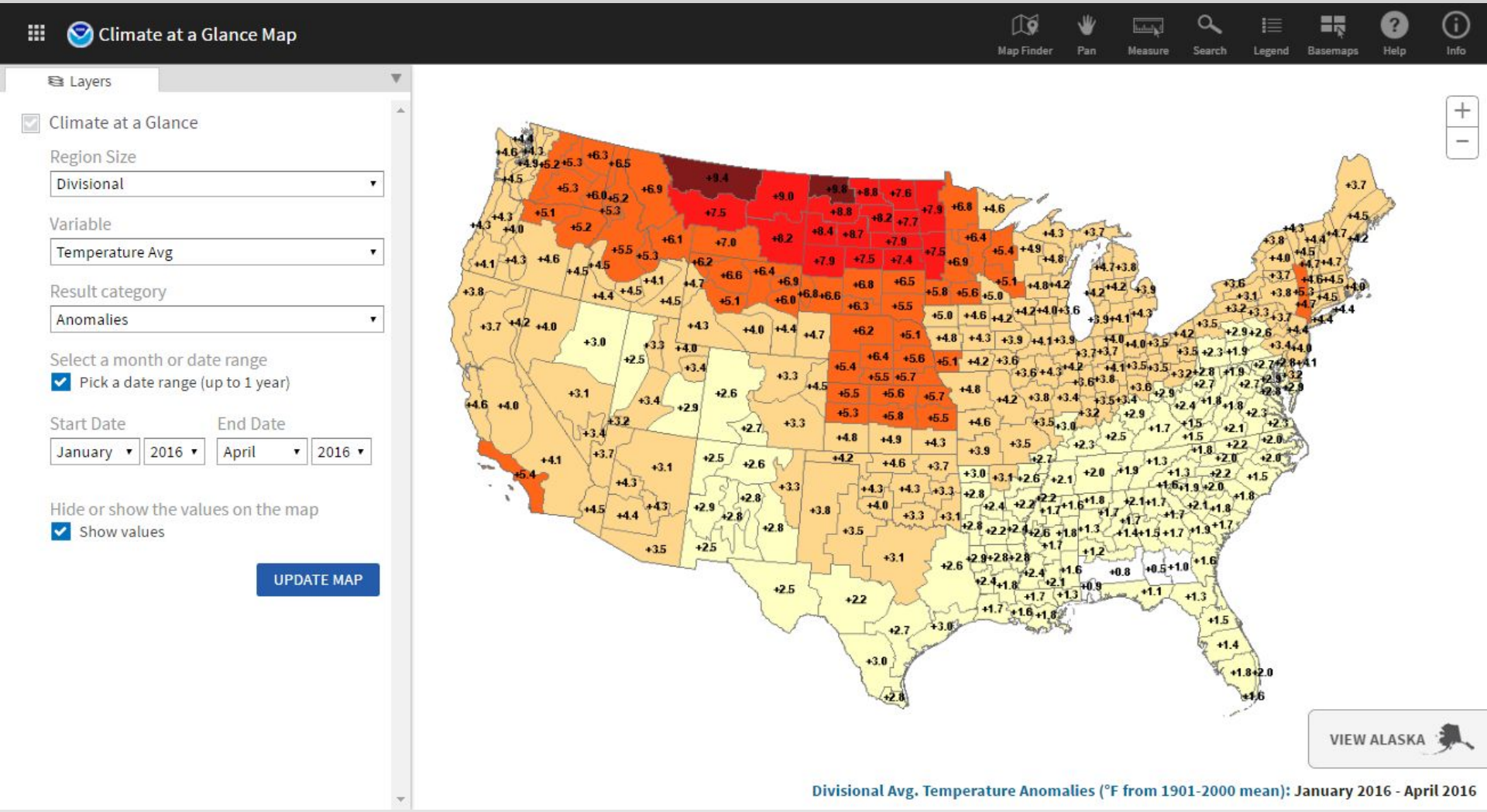
Climate at a Glance (CAG)



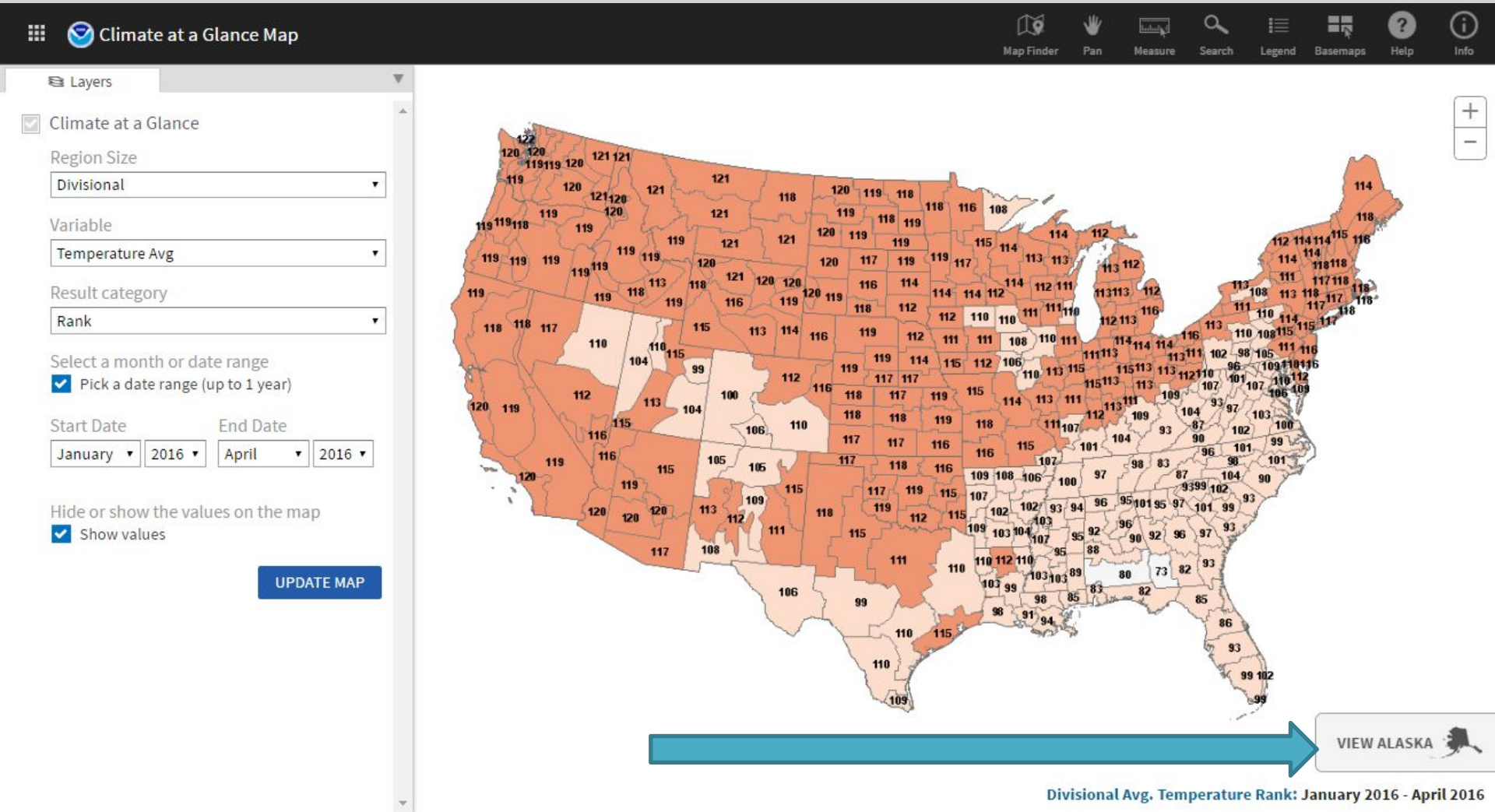
CAG Timeseries



CAG Mapping


Climate at a Glance Map
Map Finder
Pan
Measure
Search
Legend
Basemaps
Help
Info
Layers
Climate at a Glance
Region Size
Divisional
Variable
Temperature Avg
Result category
Anomalies
Select a month or date range
Pick a date range (up to 1 year)
Start Date
End Date
January
2016
April
2016
Hide or show the values on the map
Show values
UPDATE MAP
VIEW ALASKA
Divisional Avg. Temperature Anomalies (°F from 1901-2000 mean): January 2016 - April 2016

CAG Mapping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Map Finder
Pan
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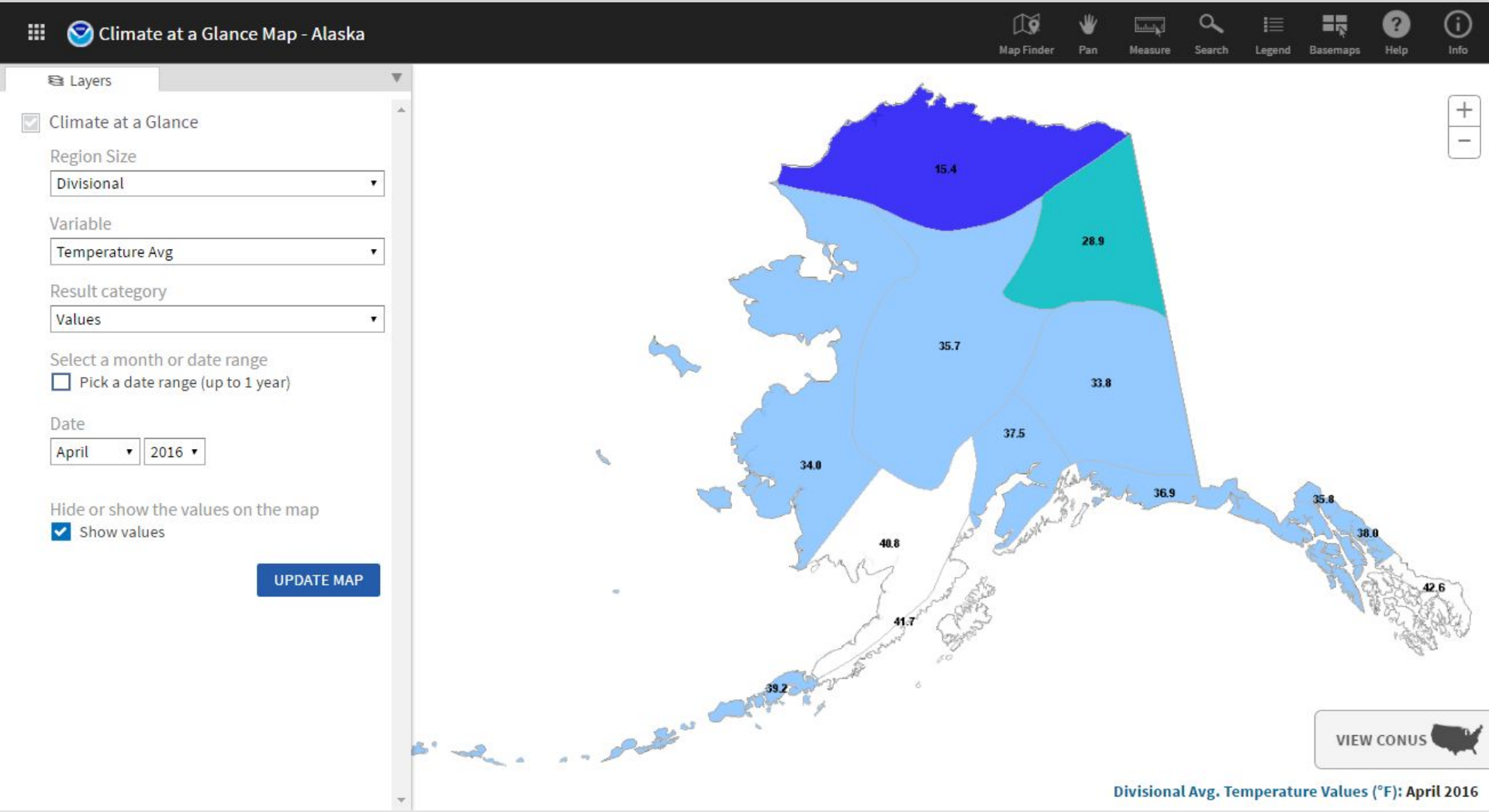
Basemaps
Help
Info
Layers
Climate at a Glance
Region Size
Divisional
Variable
Temperature Avg
Result category
Rank
Select a month or date range
Pick a date range (up to 1 year)
Start Date
End Date
January
2016
April
2016
Hide or show the values on the map
Show values
UPDATE MAP
VIEW ALASKA
Divisional Avg. Temperature Rank: January 2016 - April 2016

CAG Mapping


Climate at a Glance Map - Alaska
Map Finder
Pan
Measure
Search
Legend
Basemaps
Help
Info
Layers
Climate at a Glance
Region Size
Divisional
Variable
Temperature Avg
Result category
Values
Select a month or date range
Pick a date range (up to 1 year)
Date
April
2016
Hide or show the values on the map
Show values
UPDATE MAP
15.4
28.9
35.7
33.8
37.5
34.0
36.9
35.8
38.0
40.8
42.6
41.7
39.2
VIEW CONUS
Divisional Avg. Temperature Values (°F): April 2016

CAG: https://www.ncdc.noaa.gov/cag

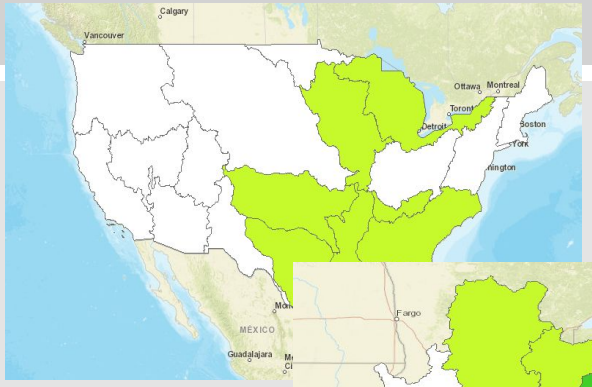
- **Time series** and **Mapping** gotchas:
  - –Multi-month “seasons” constructed like so:
  - –“Summer” (JJA) is “the 3-month period ending in August”

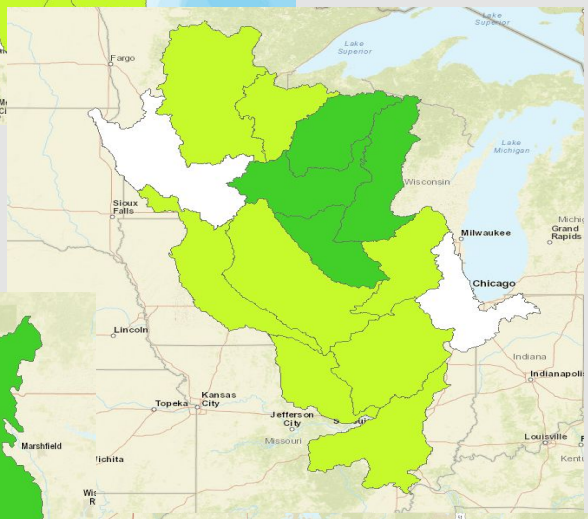
- Cities are different than shapes
- OCONUS is different than CONUS
  - –Periods of record
  - –Number of derived indices available

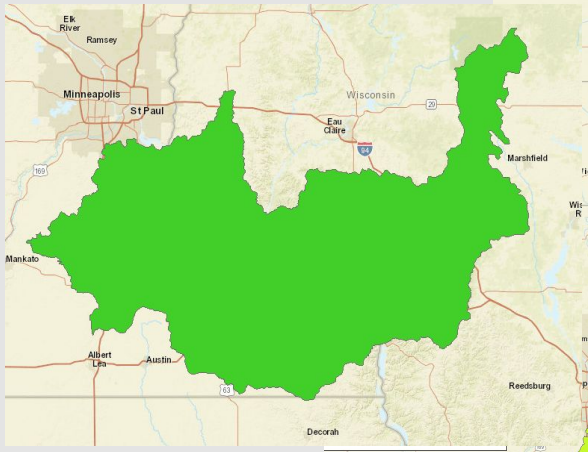
- Shapes are typically better at describing climate behavior, unless you’re absolutely married to the station, or you want to capture the range of variability at a place.

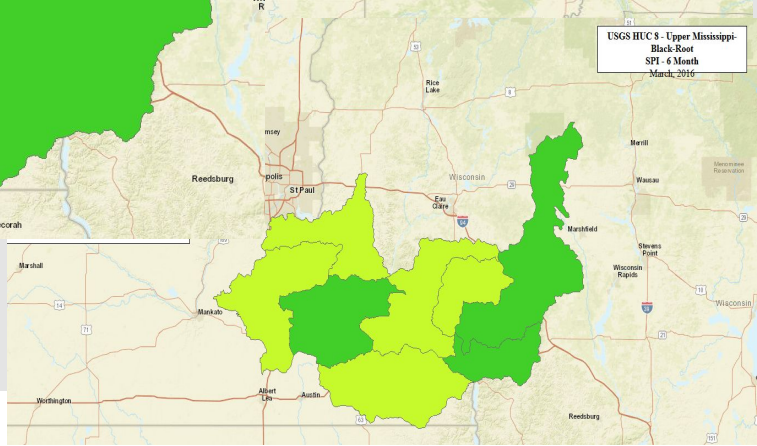
Building on CAG "requirements"

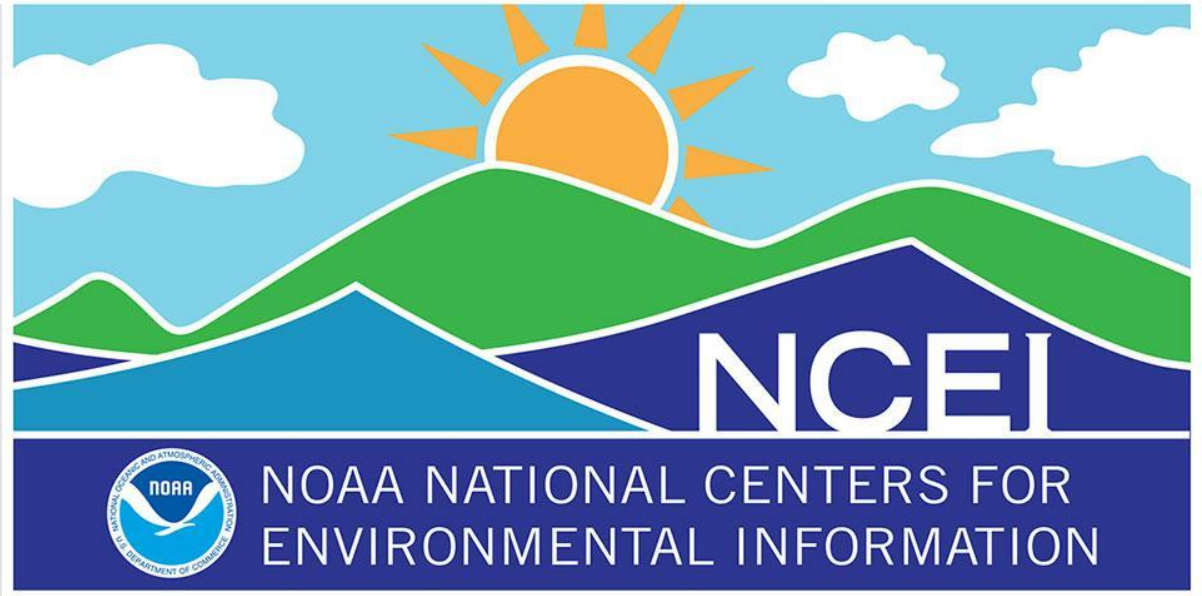
- Traditional spatial scales:
  - –Stations → climate divisions → states → climate regions → National
- Being added now (thank you to NCEI colleagues):
  - –HUCS
  - –Counties
  - –Zip Codes
- Recently expressed as "requests"
  - –CWAs
  - –RFC footprints











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